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Cost-effectiveness appraisal of immunization programmes

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This paper describes a cost-effectiveness analysis of the immunization programmes of Indonesia, the Philippines, and Thailand, using the programme costing guidelines developed for the WHO Expanded Programme on Immunization (EPI). The principal organizational features of each programme are outlined, and total costs and costs per fully immunized infant are assessed at a small sample of health centres in each country. Costs were found to average US$2.86 in Indonesia, US$4.97 in the Philippines, and US$10.73 in Thailand. At each health centre the main element of total immunization costs was fixed, so that average costs per fully immunized child fell as coverage levels and activity rates rose. The implications of this preliminary analysis are considered for each country and common managerial issues in EPI in particular, and primary health care in general, are detailed. Programme organization, health care input costs, and population accessibility are considered as explanations of the observed differences in immunization cost. The feasibility of undertaking routine cost-effectiveness monitoring of immunization and other primary health care programmes is considered.

Cost-effectiveness studies have been used in the planning of health care in many developing countries (*1–3*) and a standard approach in such studies is beginning to emerge (*4*). Many of these analyses are rigorous, data-intensive investigations and, in developed countries, are usually linked to randomized controlled trials (*5*, *6*). The studies are designed to identify the better value for money of two or more mutually exclusive health interventions. Recently, it has been suggested that a simpler and rougher comparison of cost-effectiveness should be adopted as a routine component of performance monitoring in health care (*7*), making the best possible use of available data on both resource use and programme performance indicators. While this type of audit lacks the precision of a carefully evaluated research project, it nevertheless constitutes an important practical improvement as compared with decision-making based exclusively on either the containment of costs or the maximization of performance alone, approaches which still characterize much health sector planning. Furthermore, little extra information is required for regular cost-effectiveness review. Most health ministries can identify the wage and salary costs at individual health posts without a special analysis and the same is true for pharmaceuticals and other centrally supplied inputs, thus allowing a fairly comprehensive profile of each unit's operating costs to be obtained. Similarly, most health centres keep records on the number and type of patient contacts and some of this information is available at regional or national medical statistical bureaux. In principle, then, the raw data for a preliminary appraisal of economic performance within the health sector in terms of cost per contact already exist, and little more than an amalgamation of the information is necessary to give a descriptive account of programme performance. Management guidelines for the use of pharmaceuticals have been developed in two countries on the basis of a similar analysis (*8*, *9*) and Litsios (*7*) has shown how such an analysis may be used to monitor primary health care as a whole.

Several estimates of the costs of immunization programmes in developing countries have recently been published (*10–13*), though these have provided average figures for entire programmes, and do not have a consistent methodology. In 1978, the WHO Expanded Programme on Immunization (EPI) began to explore the possibility of including a cost-effectiveness analysis in its comprehensive performance audit. It was intended to give programme managers a straightforward and consistent basis for the description of the economic character of the programme and to indicate how the same information should be used

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in analysing the relative cost-effectiveness of different patterns of organization and delivery.[a] This paper presents the information collected in the preparation and field-testing of these costing guidelines in Indonesia, the Philippines, and Thailand. The costs of fully immunizing infants with BCG and two doses of DPT are illustrated for a sample of health centres from each country. Some specific management issues encountered in the individual country programmes are discussed and common considerations in the choice of delivery strategy are detailed. Finally, the feasibility of carrying out routine cost-effectiveness appraisals is considered.

THE COSTING GUIDELINES

The guidelines comprise three sections. The first section outlines the criteria to be used in identifying a representative sample of health centres and introduces four important cost concepts: social cost, or total real resource use—comprising the services and equipment of all agencies connected with immunization—and the distinctions between capital and operating, fixed and variable, and total and marginal costs.

The second section explains the recommended costing method, covering the items listed in Table 1. Emphasis is given to the identification of costs at the individual health centres and to the capital and operating costs of supervision and management at district, regional, and national levels. Examples are given showing how to estimate the individual cost components for differently organized programmes and a simple format is proposed for summarizing the cost data. Since immunization is an integral part of basic health services in most countries, detailed suggestions are made about how to estimate the proportions of staff time, transport costs, and capital that are attributable to EPI. Such an apportionment is fundamental to any budgeting procedure and, if applied to all the activities of the basic health service, would provide a basis for assessment of the appropriateness of work, training, pharmaceutical supply, and equipment in relation to local disease patterns.

The third section of the guidelines shows several ways in which the cost and performance data can be combined with the manager's knowledge of the programme to help in decision making. These range from a simple comparison of cost profiles to examination of the relationship between costs and coverage, and include illustrative examples.

The costing procedures proposed are capable of refinement in two areas. First, the costs to users of the immunization service are not considered, because this information is not routinely available and is complicated by such factors as a possible combination of reasons for bringing an infant for immunization, e.g., mother's health, visiting the market or other business in the vicinity of the health centre, etc. However, such costs do constitute a component of the total resource use and should, in principle, be included. An estimate of the average travel cost (which may be only a part of the total cost to the user if he/she forgoes economically productive activity) for parents attending the district hospital in Thailand showed that the mean return journey to the well-baby clinic was over 14 km and cost just over 5 baht (US$ 0.25).

Cost figures may also need to be modified to correct for distorted or inappropriate domestic market prices in many developing countries. The rationale for using accounting prices in the health sector and the likely effect of such prices in the appraisal of immunization programmes has been treated in detail elsewhere (*14*, *15*).

These modifications are desirable aspects of cost-effectiveness studies and programme managers should know of them, even if they do not actually use

Table 1. Principal cost categories covered by the EPI costing guidelines

Operating costs	
Salaries	immunization team and support supervisors
Vaccines	DPT
	BCG
Transportation	staff travel allowance and expenditure
	fuel
	vehicle maintenance
	vaccine shipment
Other maintenance	kerosene/electricity/ stationery
	cold-chain maintenance
	jet injector maintenance
	other
Training	
Capital costs	
Buildings	
Vehicles	
Refrigeration and cold-chain	
Other, including spare parts	

[a] *Costing guidelines.* WHO unpublished document, EPI/GEN/79/5, 1979.

them. In other respects the costings made in the field-testing of the guidelines are complete: the resources used by all agencies contributing to the immunization programme are considered, including private contributions to transportation costs from health centre personnel. Contributions at all levels from UNICEF, WHO, and local and national agencies are also included.

FIELD-TESTING THE GUIDELINES

The unit of output or effectiveness index used for assessing performance in the Expanded Programme on Immunization is the fully immunized infant. This is a child under 12 months of age who has completed the full course of immunizations available in a particular locality. For the areas visited in Indonesia, the Philippines, and Thailand, the standard EPI immunizations were BCG and two doses of DPT. For the purpose of this analysis immunizations against other diseases (e.g., tetanus toxoid to pregnant women, poliomyelitis, and measles) and those given to children other than the target age group were not considered. Further details of these components of EPI in the countries studied are given elsewhere (*16*, *17*). The number of fully immunized infants is a better indicator of programme performance than is the number of patient contacts, since it relates directly to a measurable change in health status rather than to the process of health care.

Coverage is defined as the proportion of fully immunized subjects in the eligible age group of the pre-existing catchment population. The guidelines stress the importance of choosing a sample of health centres that reflects the different delivery conditions in which EPI operates, e.g., mobile or static clinics, with large or small immunization teams, in urban and rural areas, etc. In this way, the factors contributing to variation in cost per fully immunized infant can be identified and measured. It is envisaged that all health centres would eventually be included in the analysis.

The field-testing exercise covered a very small number of health centres, since the objective was principally to test the feasibility of using the guidelines to estimate immunization costs rather than to assess their value in decision-making. The latter would require a longer period of use on a larger scale, under the supervision of an experienced national programme manager. The study in the Philippines included 9 health centres of various sizes with different levels of coverage, and serving both accessible and scattered populations. In Thailand, 8 health centres and one hospital were studied, representing mobile and static services in catchment areas of different population size. In Indonesia, 6 health centres were studied, comprising 3 urban centres with large target infant populations (average approximately 5300) and 3 rural health centres with average target infant populations of 1500. In a separate study in Ghana, the same costing principles were applied retrospectively to compare the cost-effectiveness of 2 mobile vaccination units and 8 static clinics with limited outreach.[b] The applications of this analysis in future programme planning should be seen as indicative rather than comprehensive.

In each of the three countries studied, the immunization programme had a small national directorate concerned exclusively with immunization. Table 2 summarizes the most important organizational differences of the programmes, showing the principal immunizing staff (and their relative cost), and the schedule of the immunization programme. Since these field studies were carried out, some changes have been made in these schedules; more detailed descriptions of the organization of immunization delivery can be found elsewhere (*16*, *17*).

Total costs and number of fully immunized infants were recorded for each health centre. The costs have been converted into US $ for ease of comparison, and the 1978 Philippines figures adjusted upwards to take account of inflation (*18*). Differences in the degree of market price distortion for domestic and foreign exchange inputs were not estimated for the three countries, which are relatively efficient in comparison with many other developing countries in terms of their domestic labour market and import restrictions, particularly since all three countries have preferential trading arrangements under ASEAN conventions.[c]

Indonesia

Health centres I1, I2, and I3 are small, rural health centres; I4, I5, and I6 are municipal centres employing two vaccinators. Table 3 shows the total, average,

[b] LITVINOV, S. ET AL. *Report on Ghana feasibility studies on immunization*. WHO unpublished document, EPI/GEN/79/3, 1979.

[c] Of the three countries, Thailand's economy is probably the one in which factor (e.g., labour) and product markets operate best. Unemployment at all skill levels is relatively low in both urban and rural settings and Thailand's exchange rate has maintained parity with international currencies for over 20 years. Thai domestic prices can be translated directly into international equivalents without substantial modification. This is less true for Indonesia and the Philippines, however, where unemployment is higher. Indonesia's domestic oil subsidy and high rates of effective protection and the extent of import restrictions in the Philippines warrant the use of accounting prices for international comparisons. However, the categories of input most affected form only a small part of the immunization programme; transportation amounts to less than 7% of total costs in Indonesia and unskilled labour is unimportant. The main effect of using the official exchange rates for these two countries is therefore to understate their costs by the foreign exchange element of the programme. The fact that such a premium (probably in the region of 10%) would apply only to a small proportion of the total input of the immunization programme means that, overall, the pattern of costs outlined in this report is not substantially affected.

Table 2. Characteristics of immunization programmes in Indonesia, the Philippines, and Thailand

Characteristic	Philippines (1978)	Thailand (1979)	Indonesia (1979)
Timing	Month-long 'rounds' of immunization activity at 6-month intervals	Mobile units: 10–14 day rounds, in January and March Static units: monthly well-baby clinic and limited out-reach	Regular immunization clinics in the villages
Mobility	By hired vehicle from health centre to village	By motorcycle	Bicycle (vaccinator only)
Principal infant vaccinator	Midwife (provincial)	Midwife	Vaccinator
Approximate salary/ working day[a]	US$3.60	US$5.90	US$2.24
Nature of integration	Multipurpose personnel; twice yearly service priority to EPI	a) As Philippines b) Complete integration	Special purpose personnel

[a] Based on median salary of immunization staff in study, at 1979 level.

Table 3. Total, average, and marginal costs of immunization in the Indonesian health centres

Health centre	No. of children immunized	Total cost (US$)	Average cost per immunized child (US$)	Marginal cost[a] (US$)	Coverage (%)
Rural					
I1	932	2330	2.50		80
I2	1048	2317	2.21	negative	80
I3	1601	2369	1.48	0.09	92
Urban					
I4	722	3263	4.52		13
I5	1002	4028	4.02	2.73	20
I6	1563	3814	2.44	negative	29

[a] The marginal cost is the incremental cost of vaccinating children, divided by the number of extra children vaccinated. Thus the extra cost at I3 (2369 – 2317 = 52) is divided by the number of additional infants immunized (1601 – 1048 = 553) to give 52/553 = 0.09.

and marginal costs of each of these centres, together with the levels of coverage of eligible infants, estimated from health centre records.

Philippines

Table 4 summarizes the cost, output, and coverage data for the health centres studied in the Philippines. These centres were chosen to represent first, relatively homogeneous catchment areas, differing only in population size (P1, P2, and P3) and second, health centres that were known to have low (P4, P5, P6) or high (P7, P8, P9) levels of coverage. Although the limitations of sample size in this preliminary assessment are apparent, the analysis does bring out certain important managerial problems.

Thailand

Immunization activity was organized differently in the two districts studied in Thailand. Health centres T1 – T4 in district A operated in a manner similar to that of the Philippine centres, with "rounds" of immunization held in mobile clinics twice yearly. Infant immunization was not available on demand at health centres in this district. In district B, centres

Table 4. Total, average, and marginal costs of immunization in the Philippine health centres

Health centre	No. of children immunized	Total cost (US$)	Average cost per immunized child (US$)	Marginal cost (US$)	Coverage[a] (%)
Island centres					
P1	228	1425	6.25		48
P2	296	1817	6.14	5.76	67
P3	541	1946	3.60	0.53	72
Low coverage					
P4	178	1250	7.02		18
P5	265	1797	6.78	6.29	44
P6	365	1761	4.82	negative	21
High coverage					
P7	396	1595	4.03		56
P8	450	1635	3.63	0.74	51
P9	2178	5456	2.50	2.21	72

[a] Coverage estimates are based on the National Economic Development Agency population growth forecast for the whole country, and in all areas visited exceed the actual number of recorded births. These figures are thus likely to underestimate the true coverage levels.

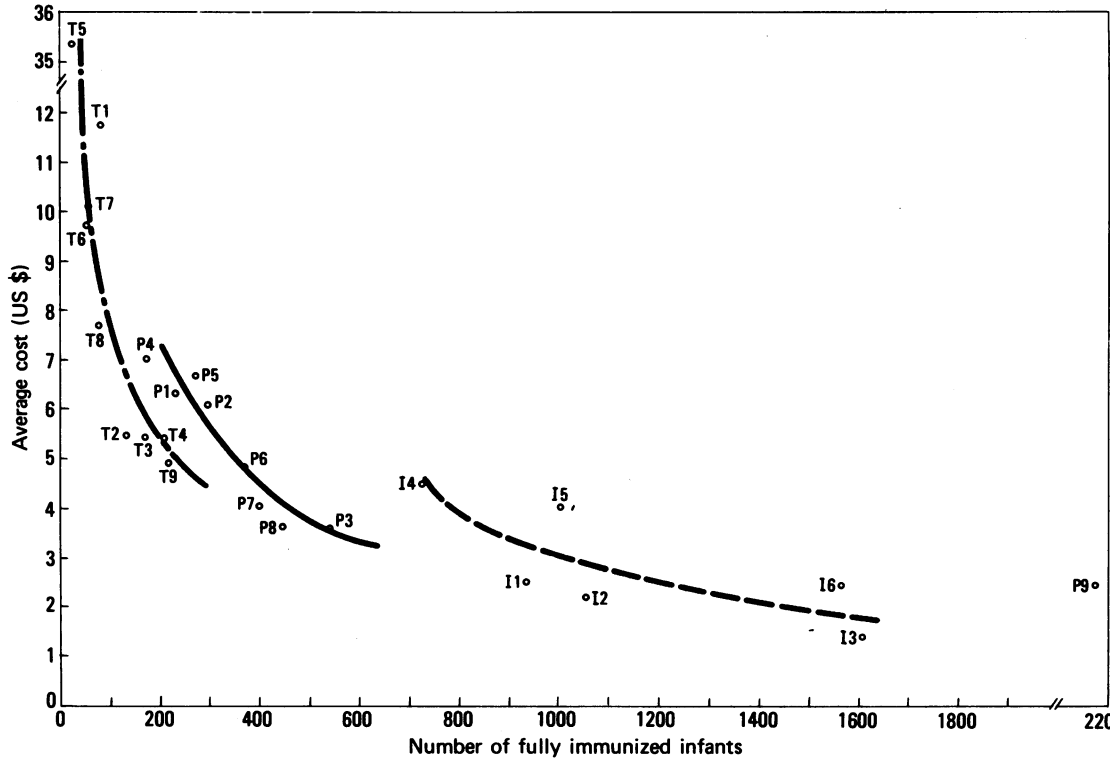

Fig. 1. Average cost per fully immunized infant at all health centres, at 1979 prices.

Table 5. Total, average, and marginal costs of immunization in the Thai health centres

Health centre	No. of children immunized	Total cost (US$)	Average cost per immunized child (US$)	Marginal cost (US$)	Coverage (%)
District A					
T1	71	832	11.72		100
T2	132	734	5.56	negative	90
T3	162	897	5.54	5.43	90
T4	189	1032	5.46	5.00	84
District B					
T5	13	464	35.69		54
T6	51	495	9.71	0.82	150[a]
T7	56	568	10.14	14.6	75
T8	67	522	7.79	negative	160[a]
T9	216	1072	4.96	3.69	200[a]

[a] Coverage figures over 100% are caused by an influx of people living outside the district to attend the well-baby clinic sessions.

T5 – T9 undertook very limited outreach activity—one or two multipurpose journeys each month—and most immunizations were given at the health centre in "well baby" clinic sessions. District A had a population of 100 000, while district B had 62 000; the total population density in A was only about half that in B and the average area covered by each health centre in A was nearly four times that of T9. Health centre costs and immunization activity are summarized in Table 5.

The composition of costs was analysed in each of the three field studies and cost profiles, showing the proportions of total cost attributable to different functions, are illustrated in Table 6 for one health centre in each country.

Fig. 1 shows the average cost per fully immunized infant at each of the health centres in the study. Although a classic U-shaped average cost curve appears to exist, the data conceal large differences in the organization, relative factor costs, and coverage of the programmes; it is, therefore, not possible to use the information to describe an internationally valid optimum immunization capacity.

ANALYSIS OF COSTS

Certain management applications may be illustrated from these preliminary data. The issues may be known intuitively by programme managers, but one of the purposes of the guidelines is to make explicit, in a consistent fashion, the economic context of decisions relating to the immunization programme.

Table 6. Percentage distribution of total costs in three health centres

Item	Health centre I3	P7	T2
Salaries and allowances			
health centre	25.0	31.2	28.3
district	6.8	1.8	15.5
regional	3.0	2.8	3.7
national	2.7	17.2	0.4
Subtotal	37.5	53.0	47.9
Transport			
health centre	–	9.9	8.8
district	10.9	0.7	
regional	2.1	3.8	0.4
national	1.5		
Subtotal	14.5	14.4	9.2
Vaccines			
DPT	8.9	9.4	10.2
BCG	3.7	2.2	2.5
others	8.9	–	–
Subtotal	21.5	11.6	12.7
Training	8.1		0.6
Other operating costs	10.4	1.7	3.2
Capital costs			
health centre	13.2		
district	2.2		
regional	2.0		26.4
national	0.6		
Subtotal	18.0	19.3	26.4

This section examines first the problem common to all three programmes of the large fixed cost element in immunization; the data on costs from Tables 3 – 5 are then used to identify some country-specific management issues revealed by the field testing; finally, the inter-country cost differences are analysed.

Fixed and variable costs

The components of total cost that do not vary with the level of immunization activity are capital costs (i.e., an estimated figure to account for the use of vehicles, buildings, and equipment) and each health centre's share of district, regional, and national management and supervisory costs and capital items. On the other hand, salary costs of health centre staff, transportation, and vaccine use vary directly with the number of immunizations given. In the Thai health centre T2, 50.2% of total annual costs at 1979 activity levels were fixed, and the corresponding proportions for the health centres P7 and I3 were 46% and 42%, respectively. Fig. 2 shows the fixed and variable components of total costs for health centre I3. The lower the level of immunization activity, the greater the proportion of total costs that are fixed, and the higher the average cost per fully immunized infant. Within each country, the absolute value of the fixed costs was similar for each centre because many of the components were apportionments of overall managerial costs, which were divided equally among the health centres. The importance of the fixed share of basic health services costs is particularly apparent in Thailand, where a combination of small catchment populations and low attendance rates at health centres resulted in extremely high costs per fully immunized infant.

In these circumstances, cost reductions are possible either by reducing fixed costs or by increasing the

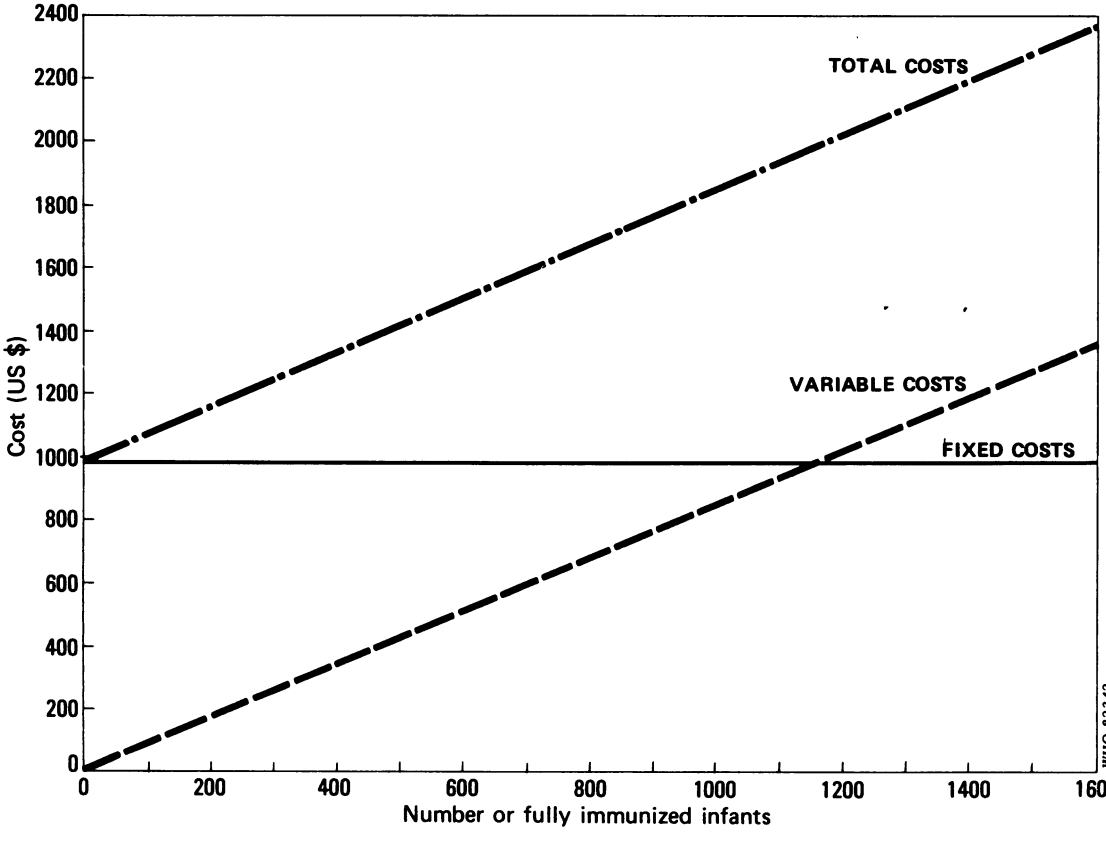

Fig. 2. Fixed, variable, and total costs at Indonesian health centre I3, at 1979 prices.

activity levels of existing health centre staff. By their nature, fixed costs are not easily manipulated in the short term. Furthermore, some of these items (e.g., most notably the capital items) are shared by many primary health care programmes, and so may not be modified in the interests of a single subprogramme. However, the fixed costs that are predominantly associated with EPI, such as the resource inputs of a managerial and supervisory character, together with the associated transport costs, might be distributed in rough proportion to the volume of immunization work, as measured by attendances at antenatal and well-baby clinics throughout the country. Similarly, some flexibility in the allocation of cold-chain equipment should be possible, with refrigerators being provided only to populations of a certain size. The usual practice of providing standard health centres with a common staffing pattern in all administrative districts, whatever the catchment population, results in inequitable resource allocation and contributes to the variations in cost-effectiveness of the health services. This is a managerial issue facing all basic health services, and requires either greater uniformity in the population served by the health facilities or greater flexibility in provision standards in order to provide equitable health services.

Management implications: individual programmes

It is clear from Table 3 that the urban and rural health centres in Indonesia are economically quite distinct, in terms of both their average costs and their coverage levels. The average costs at the rural centres, which were between US$1.48 and US$2.50, were not only lower than the mean costs at the urban centres, but were also low relative to commonly accepted average costs. At all health centres in the sample, the average and marginal costs fell as total output increased. However, marginal costs in the rural units were very low—it cost only 9 cents more to vaccinate the extra children at I3—while in the urban health centres marginal costs were higher and close to average costs. From an economic viewpoint, the differences in average and marginal costs indicate that, if there were competition for resources between rural and urban health centres, priority should go to the rural centres, since each dollar's expenditure there goes further. The urban health centres are not even better performers in terms of their coverage levels. Since similar numbers of infants were immunized at each of the centres in the sample, it might be suggested that either immunization activity should be increased or costs reduced at the urban health centres. Although these centres employ two vaccinators, their coverage rates remain low because many people use private medical facilities for infant immunizations. The problem facing the manager is whether to concentrate on raising the coverage of the urban health centres, thus employing existing resources more fully, or to redeploy resources by transferring staff posts to the rural centres. In practice, it may not be possible to take the latter course of action, since the Indonesian programme is an integral part of the primary health system. In any case, the first step would probably be to check the validity of these initial findings by expanding the sample of costed health centres.

At the three island health centres in the Philippines, there was a general fall in the average cost per fully immunized infant as numbers increased. The drop in marginal cost was dramatic; health centre P3 fully immunized over 80% more infants than did P2 at less than 10% more cost. Furthermore, the extra coverage achieved by P3 (which might be taken as an indicator of better management at the health centre) was relatively small, indicating that there was probably some spare capacity in the resources devoted to EPI at the other two health centres. The fact that average and marginal costs fell rapidly as output increased suggests that a large proportion of the total cost is fixed or insensitive to changes in output. Indeed, the range of total costs at all of these health centres is one-third of the range of output.

Performance at the low and high coverage units showed a similar picture of costs being most sensitive to total output. Coverage level is perhaps an inappropriate basis on which to select health centres for cost assessment, since it conceals information which may be causally related to performance, such as population dispersal, difficulty of terrain, poor staff morale or supervision, and size of target population. The data suggest that the extra costs associated with population accessibility are relatively low in the health centres studied; P7 had an accessible population, whereas P6 had a dispersed population which was difficult to reach at certain times of the year. The relationship between accessibility and cost is important in assessing the likely costs of expanding the programme into previously uncovered areas and in determining the most cost-effective method of providing health care to dispersed populations.

At health centre P9, a large urban centre, four separate small immunization teams worked simultaneously throughout the catchment area of the centre. The resulting coverage level was among the highest and the average costs the lowest of those seen in the Philippines, making this the best immunization unit in terms of overall performance.

On the whole, the costing of health centres in the Philippines programme revealed the importance of population size and the possible disadvantages of using an immunization team of standard composition for a fixed period, when the target population is relatively small.

In Thailand, with the exception of T9, the costs at

all the health centres in district B were lower than those in A; however, immunization rates were also lower, so that the more costly strategy was actually more cost-effective. The closeness of marginal costs to average costs at T3 and T4 indicates that these units may be operating at almost full capacity, while the very high average costs at T5 indicate that it is working substantially below capacity. This is in part a result of general low utilization of primary health centres in this part of Thailand and partly because this particular health centre had a very small target population, some of whom may have had their children immunized at T6. The number of target children immunized is once again the most important factor in cost-effectiveness. In the Thai study, this was more important than either the degree of mobility of services or the scheduling of immunization sessions. T9 had a very large effective catchment area, with patients travelling an average total of 14 km to attend the well-baby sessions; consequently, this centre had the lowest average costs. In Thailand, the management of EPI and other primary health care programmes is faced with high fixed costs at each of its units and with health centre facilities that do not relate to the size of the population to be served. Some health centres are therefore underused, with spare capital and slack time, while others are working at full capacity.

If the data in Fig. 1 were for matched health centres from a single programme, it would be clear that average costs would be minimized when populations of 1500 – 2000 were being fully immunized, so that the EPI would be more cost-effective if it were planned on a district, rather than an individual health centre basis. It is noteworthy that, in spite of programme differences, a steady fall in average costs is observed, suggesting that the number of accessible infants is a more important determinant of programme cost differences than are details of the organization of the programme.

Differences in costs between programmes

The variation in cost among the three countries can be attributed to several factors, notably the differences in relative cost of the common inputs, and the way in which these inputs are used. The cost differences also reflect access difficulties, either in the form of popular reluctance to use basic health services, or physical and administrative problems in reaching large numbers of target children.

In terms of immunization strategy, there were close similarities between the programme in the Philippines and in Thailand's district A, as shown in Fig. 1. Within Thailand, however, there were differences in the amount of work undertaken by mobile teams and this affected the transportation component of costs accordingly. The Indonesian programme was also distinct in that its vaccinators did not use motorized transport. Furthermore, the majority of infant immunizations in Indonesia were done by one vaccinator at the health centre, whereas in the Philippines, the immunization team commonly included a midwife, a public health nurse, and a sanitary inspector. Although there are variations among the health centres within a particular programme, the EPI organization in Indonesia is generally the responsibility of a single vaccinator, with a small amount of infant immunization being done by the midwife at the health centre. The vaccinator handles his own record-keeping and immunization schedules, as well as the cold-chain arrangements at his health centre. Thai personnel in rural health centres, which typically have a staff of two, share much of the EPI work and all of the centres visited had at least one official motorcycle. In the Philippines, where the immunization team was usually larger, transportation was usually by hired motor-tricycle. The delivery strategy is thus one factor contributing to the low median EPI cost in Indonesia, but is not the most important one. If it were the principal explanation, then the Philippines, rather than Thailand, might be expected to be the most expensive of the three programmes under review.

Relative wage costs of primary health personnel with comparable qualifications vary considerably in the three countries, as illustrated in Table 7, although the differences in unit wage costs are much smaller than the differences in costs per fully immunized infant.

The biggest single factor affecting the costs, internationally as well as domestically, appears to be the work rate of the individual immunization teams, as measured by the number of fully immunized infants. This is determined by the size of the catchment population and the level of coverage achieved by the team, and the implications of this extend beyond the immunization programme, to the general planning of basic health services and the type, size, and organization of services at first point of contact. EPI, like other components of the basic health service, can

Table 7. Comparative wage costs, in US$, per working day in the three countries, at 1979 levels

Country	Midwife	Sanitarian
Indonesia	5.70	2.24 (vaccinator)
Philippines	3.60 (provincial) 4.20 (national)	3.05
Thailand	5.90	4.05

be made more cost-effective either by reducing fixed costs (by building smaller health posts) or by making existing facilities serve larger populations. Within individual subprogrammes, it may be possible to centralize some services, such as refrigeration and supervision, or to use multipurpose mobile health teams in certain areas. Appraisal of the feasibility of implementing such changes should, however, give due regard to any foreign exchange shortages and to the import content of the strategies.

DISCUSSION

The achievement of a high overall level of immunization in a given population is certain to be accompanied by an increase in the marginal cost of immunizing infants in the remote areas. The programme manager's concern is not to equalize costs per fully immunized infant, but to ensure that any differences are kept to a minimum. There are numerous possible explanations for the observed average cost variations in the sample of health centres studied, but in all three countries the presence of a high fixed cost component is most noticeable. Much of this, in particular the physical capital and supervisory structure, is inherited from past decisions and the promotion of optimum-size facilities is clearly a long-term planning concern. In this respect, the analysis of EPI costs highlights a problem common to all basic health services in these countries. The widely publicized notion of a pyramidal structure in primary health care (*19*) does not necessarily imply complete standardization of facilities at the first level. Indeed, allocation of first level health units on the basis of the existing administrative structure commits the health planner to a highly uneven pattern of capital and operating expenditure. The size of the basic catchment area may therefore have to be defined independently of pre-existing district or subdistrict boundaries.

In the shorter term, however, it may be possible to reduce average costs at small, relatively inefficient health units by increasing the centralization of certain services (such as refrigerators), and maintaining and operating the cold-chain on a district, rather than an individual health unit basis. The size of the target population should also be considered when planning supervisory activities, which account for one-fifth of the cost of fully immunizing an infant.

To identify the most efficient way of expanding immunization activity, a rough quantitative notion of the relative importance of factors contributing to cost variation is needed; the guidelines provide a format for such an assessment. For example, the relationship between population density and immunization costs may be measured by comparing the total cost of EPI at a sample of health centres that are similar in all major respects except their population density. Similarly, the relative costs and cost-effectiveness of various mobile and static services can be estimated quickly. For example, the results obtained in Thailand showed that increased use of mobile services was actually more cost-effective in areas with a dispersed population.[d]

Even within the constraints of an essentially integrated programme, there is scope for choice in both the deployment of capital items and the organization of supervision. Cost-effectiveness studies offer a means of assessing past decisions, such as the allocation of mobile teams, and provide evidence on the economic logic of prevailing systems. In choosing the way in which an immunization programme is to expand, there are three basic alternatives. In the countries under comparison, as in most countries, coverage in existing programme areas is incomplete, not all of the country is included in the programme, and there are other diseases against which immunization may be desirable. Expansion may therefore mean:

— improving coverage levels in the existing programme areas
— expanding the coverage to new areas
— adding new vaccines to the programme.

The likely cost-effectiveness of each alternative should be estimated before a policy decision is made.

Each option would require different resources: improved coverage may require additional supervision, more mobility, and more of the existing vaccines; expansion to new areas will involve new capital, training, and operating costs; introduction of new vaccines will also require training and publicity, as well as the actual vaccine cost. From an economic viewpoint, these strategies may be undertaken simultaneously, singly, or in any combination and the cost per additionally immunized infant is likely to be different for each option.[e] The most cost-effective way to expand can be assessed using the known costs of the programme and estimates of the likely number of fully immunized infants achieved by each strategy, though there is a strong case for an initial effort to raise coverage in existing programme areas where this

[d] A similar result was obtained for the EPI in Ghana, but the overvaluation of Ghana's currency at the time resulted in an understatement of the foreign exchange component of the mobile services cost, which should therefore be regarded as much higher for purposes of comparison. (See footnote *b*, page 623).

[e] Since the addition of new vaccines changes the quality of the programme's activity, this option cannot be compared with the other two in terms of cost per fully immunized infant. The effect of adding new vaccines is to change (probably to reduce) the cost per case/death prevented, and this would constitute a more general yardstick for choice among all three alternatives.

is at a low level as, for example, at health centres I4 – I6, in the above examples.

CONCLUSIONS

The above analysis and the management implications derived from it are preliminary observations based on the field-testing of EPI's costing guidelines at a small sample of health centres. Initial experience with the guidelines has indicated that (*a*) a small amount of new data is necessary for their application and (*b*) that they can be used to analyse other areas of primary health care performance, provided comparably robust indicators of output (as opposed to process) can be developed. Research is now being carried out in Thailand to analyse the costs of malaria case detection by different strategies and institutions, using techniques identical to those outlined here. The use of cost-effectiveness appraisals of programme performance appears to be limited more by the inadequacy of current measures of programme performance than of programme cost, since information on costs of vaccine, cold-chain equipment, and salaries is usually easily available. The greatest problem in determining EPI costs is in estimating the time spent by the various health workers on a particular programme. However, it is not difficult to learn the basic principles to be applied in such an exercise, and once this has been done, it becomes possible to study large numbers of centres. Since the information generated by costing any single activity is also of potential value for the monitoring of other programmes, it would appear to be economically sound to undertake such costings for multipurpose monitoring and planning of primary health services.

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RÉSUMÉ

ÉVALUATION COÛT-RENDEMENT DES PROGRAMMES DE VACCINATION

Cet article présente les résultats de trois brèves études sur les coûts des programmes de vaccination, entreprises au titre de l'essai des directives en matière de coûts émises par le Programme élargi de vaccination (PEV). Ces directives ont pour but de permettre l'évaluation simple et régulière du coût des activités de vaccination en établissant la dépense par nourrisson complètement vacciné et les facteurs qui contribuent aux variations de ces coûts moyens. Les auteurs ont résumé les détails des directives en montrant les principales catégories de dépenses, renouvelables et d'investissement, et en indiquant brièvement les procédures à appliquer pour les évaluer.

Ils ont comparé l'organisation des programmes de vaccination en Indonésie, aux Philippines et en Thaïlande et calculé les coûts totaux et moyens par nourrisson complètement vacciné dans chacun des centres sanitaires visés par l'étude. En Indonésie, les coûts se situaient entre $1,48 et $4,52; aux Philippines, entre $2,50 et $7,02; et en Thaïlande, entre $4,96 et plus de $35. Ayant relevé les éléments fixes et variables du coût total dans chaque centre sanitaire, on a constaté qu'une forte proportion des dépenses étaient fixes dans tous les programmes. L'article montre l'incidence sur le rapport coût-rendement de la couverture effective de la population et traite des questions de gestion particulières à chaque pays pour montrer la valeur potentielle de cette surveillance économique.

Les différences de coût entre programmes étaient considérables; en effet, le coût moyen de la vaccination complète d'un nourrisson était de $2,86 en Indonésie, de $4,97 aux Philippines et de $7,79 en Thaïlande. Ces différences relatives tiennent partiellement aux facteurs suivants: importance relative des différents coûts de fonctionnement (par exemple, niveaux des salaires); association différente des ressources mises en œuvre (par exemple, proportion de personnel qualifié et de personnel non qualifié); et limitations d'accès. Toutefois, le facteur le plus important est la variation entre les niveaux d'activité des centres sanitaires des différents pays, qui révèlent des limitations d'accès de toutes espèces. L'article étudie les conséquences de ce fait pour la planification du programme de vaccination notamment en ce qui concerne la part attribuée aux dépenses fixes, et, dans un registre plus étendu, ses conséquences pour la planification des services de santé de base. Il traite aussi des incidences financières probables de diverses stratégies d'expansion et insiste sur la possibilité d'exercer une surveillance coût-rendement régulière dans les autres services de santé de base.

En ce qui concerne les directives PEV, les auteurs estiment que leur application est économique étant donné le faible volume de nouvelles données qu'elles exigent; en outre, elles pourraient être appliquées dans d'autres domaines que le PEV, pour autant que des indicateurs de rendement, de valeur comparable, puissent être mis au point. Enfin, comme l'information obtenue en établissant le coût de

chaque activité a une valeur potentielle pour la surveillance d'autres programmes, il semble que l'on pourrait réaliser des économies d'échelle en procédant à de telles évaluations à des fins de surveillance polyvalente et pour la planification des services de santé primaires.

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